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Factors Related to Errors in Ex Ante Evaluation of Agricultural Projects in Developing Countries

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Abstract

This study examines 20 developing country agricultural projects regarding discrepancies between the expected project results (ex-ante) and the actual project outcomes (ex-post). Discrepancies between ex-ante and ex-post evaluation include mean cost overruns of 47 percent, and time overruns of 50 percent. Political instability, change in foreign exchange rates, change in GDP, change in consumer prices, and underestimation of inflation rate at appraisal explain 30 to 60 percent of the variation in dependent variables.

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Introduction

This study is primarily concerned with agricultural development projects, often referred to as "the cutting edge of development" in developing countries.[1] Agricultural development projects can be viewed as parts or building blocks of investment plans.They are also part of an overall development plan or strategy and a broader planning process to hasten the economic growth of the country. As Gittinger states, "It is the smallest operational element prepared and implemented as a separate entity in a national plan or program of agricultural development. It is a specific activity, with a specific starting point and a specific ending point, intended to accomplish specific objectives".[2] Therefore, projects are the smallest units of undertakings, the size of which is economically, technically and administratively feasible.

Projects enable decision makers to allocate scarce investment resources properly and in a balanced manner within the sector as well as among various sectors of the developing economies, taking into consideration the linkages among them. In addition, well prepared projects have been the major means of obtaining assistance from abroad in the form of loans and grants from the developed to many developing countries. The assistance comes either bilaterally or multi-laterally through international development funding agencies. Project type assistance is preferred by the donor or aid agencies because it is more efficient to plan, monitor and evaluate, and can be controlled by their own feasibility and evaluation standards. For the borrowers, the total use of resources for development, with conscious and systematic combinations of external

assistance and local resources, will be more feasible if more investments that are available can be analyzed as projects.

The dollar volume of loans and grants flowing annually into developing countries is in the billions, even without considering the large amount of funds, both in kind and cash, contributed by the host countries out of their scarce resources. The magnitude of even small percentage deviations or errors in ex-ante evaluation of time, costs and economic rate of return (ERR) of projects on a global basis, therefore, is very large. The more the accuracy of ex-ante predictions is improved, the greater the volume of funds available for the most efficient project investments.

Agricultural projects in developing countries are implemented in an environment "where various biological and economic risks dominate decision making.[3] Compounding this situation is Norgaard's argument that uncertainty has increased in recent years. For example, "during this past decade energy prices soared and softened, real interest rates ranged from less than zero to greater than ten percent, construction costs rose and fell faster than the overall inflation rate and grain prices 'roller coastered' on the international market. In addition, environmental, indigenous and other groups began to intervene in the course of projects."[4]

The discrepancies between projections and actual outcomes of the projects are related to the difficulty of doing good risk assessment or analysis. Of the major risk and uncertainty factors, natural calamities, occurrence of wars or political instability, and internal and external characteristics of the macroeconomic environment are of primary importance for ex-ante evaluation of agricultural projects in developing countries. However, a project planning

agency, even when realizing the significance of such factors, may not be able to accurately predict those which are beyond its control. As a minimum, sensitivity or breakeven analysis is needed to determine "robustness" of projects to alternative futures.

The major emphasis of this analysis is to explain the deviation between expected project results (ex-ante, i.e., at the point of project approval) and the actual outcome ("ex-post", i.e., at the point of project implementation) and to determine the factors correlated with this deviation. Such findings should be useful in assisting project planners and policy makers in more effective planning and implementation of agricultural projects in developing countries.

Methodology

The relationship between deviations of actual completion period, total cost and economic rates of return of the projects from ex-ante evaluation estimates and factors related to these deviations may be defined in a recursive equation system (if each of the endogenous variables can be determined sequentially) as follows:

(1) $TD = f(D_{1-n}, P_{1-n}, I_{1-n}, A_{1-n}, W_{1-n}, E_{1-n})$

(2) $CD = f(TD, D_{1-n}, P_{1-n}, I_{1-n}, A_{1-n}, W_{1-n}, E_{1-n})$

(3) $RD = f(TD, CD, D_{1-n}, P_{1-n}, I_{1-n}, A_{1-n}, W_{1-n}, E_{1-n},)$

where

RD = Deviations in expected economic rates of return (EER)

TD = Time overruns, i.e., delays in completion of the project

CD = Cost overruns, i.e., deviations in the total cost of the project

D = Changes in project design/scope characteristics (e.g., D_1 = scope and D_2 = unit quantities)

P = Other project characteristics (e.g., P_1 = total cost, P_2 = length of implementation, and P_3 = appraisal inputs)

I = Price changes (e.g., I_1 = inflation, I_2 = input prices, I_3 = consumer prices, I_4 = money growth, and I_5 = foreign exchange)

A = Administrative and institutional characteristics (i.e., number of constraints observed)

W = Weather/climatological characteristics (dummy variable on existence of unusual adverse conditions)

E = Macro-economic and political characteristics (E_1 = Δ in GDP, E_2 = dummy variable on occurrance of war, political instability)

The structural model specification was based on the hypothesis that time overruns or delays in completion of the projects are determined by project characteristics, price changes, and administrative, institutional, weather, macro-economic and political characteristics. Cost overruns or deviations in the total cost of the project are then determined by time overruns and by project characteristics, price changes and administrative, institutional, weather, macro-economic and political factors. Finally, ERR deviations are determined by the two previously determined endogenous variables (time and cost overruns) and by price changes, and administrative, institutional, weather, macro-economic and political characteristics. Equations (1), (2), and (3) presented above are recursive equations and can be estimated by ordinary least squares if the residuals are uncorrelated across equations.

The best available source for secondary data on World Bank-assisted agricultural projects which have already been implemented, reviewed, and

the performance results published is the Annual Review of Project Performance Audit Results. These are published annually by the World Bank and were used to develop a preliminary list of projects. Then, in consultation and cooperation with some of the representatives of the project host/recipient countries, a list of 30 potential observations was obtained. From this list, 20 agricultural projects from 16 developing countries of Asia, Africa and the Middle East which are of uniform type and without missing values were selected and coded to maintain confidentiality. Some descriptive statistics of these projects derived from the World Bank Audits and other secondary sources (e.g., ADB) are presented in Table 1. These data were then used to empirically estimate the foregoing conceptual model relating deviation in ex-ante evaluation to factors related to deviations. For a detailed description of the data collection and analysis, see the M.S. thesis by Oo.[5]

Regression Models and Results

The regression results in Tables 2, 3, and 4 represent alternative equations (e.g., TD_{1-4}, CD_{1-6} and RD_{1-3}) for the TD, CD, and RD Models. A total of 10 variables were statistically significant at the 0.20 level in one or more equations in explaining the variations in ex-ante evaluation deviations in 20 developing country agricultural projects. Selected non-significant variables are included where necessary for conceptual correctness.

Approximately 40 percent of the variation in time overruns can be explained by variations in total project cost and political instability variables in the TD(1) equation. When changes in unit quantities of inputs were included in the regression, the explained variance increased from approximately 40 percent in the TD(1) to 46 percent in the TD(3)

equation. About 57 percent of the variation in cost overruns can be explained by variations in higher inflation than anticipated at appraisal, the change in F.E. rate and the change in GDP variables in CD(2) equation.

Finally, approximately 40 percent of the variations in ERR deviations among the 20 sample agricultural projects can be explained by variations in change in consumer prices, political instability variables and the endogenous variable cost overrun (CD).

The RD Models in Table 4 indicate that the addition of some key variables to the above three regression equations resulted in the changes in relevant coefficients and measure of goodness of fit of the regression models. Not only are the independent variables added to the regression insignificant, but the regression coefficients of the significant variables in the regression equation also decreased. The measure of goodness of fit or R^2 value increased when the additional variables were included in the regression, but the adjusted R^2 value decreased. Likewise, the overall model F-value was smaller and the F-ratio larger, when the number of the independent variables was increased in the regression equations.

Conclusions and Implications

In conclusion, approximately 40 percent of the variation in time overrruns and about 57 percent of the variations in cost overruns is explained by respective predetermined variables. But only one-third of the variation in economic rate of return deviations among the 20 sample agricultural projects is explained by the variables, although the F-ratio of the equation is greater than "1" and significant at the 5 percent level. Some other potential explanatory variables such as yield per area of crops/trees, prices for project products, and total project benefits in

Table 1: Mean Values, Standard Deviations and Ranges for Factors Associated With A Sample of Agricultural Projects

Factors	Mean %		Std. Dev.	Range
Deviation Measures				
ERR Deviation (RD)	2.3+		42.9	(-)54.0 - 91.0
Time Overrun (TD)	49.8	-	45.1	(-) 9.0 - 176.0
Cost Overrun (CD)	46.9	-	44.8	(-)12.0 - 148.0
Design/Scope				
Changes in design/scope (D_1)		65*		
Changes in unit quantities (D_2)		65**		
Other Project Characteristics				
Total cost-U.S. $ m.(P_1)	77.1	-	60.0	11.7 - 211.0
Completion time-months (P_2)	86.5	-	31.6	45.0 - 188.0
Appraisal-man-days/$m.($P_3$)	2.2	-	2.1	0.1 - 7.2
Price Changes				
Higher inflation (I_1)		60		
Higher prices of inputs (I_2)		75		
Change in consumer price (I_3)	14.1	-	7.9	6.0 - 40.0
Change in money growth (I_4)	21.0	-	7.5	13.0 - 36.0
Change in F.E. rate (I_5)	10.2	-	19.3	(-)12.0 - 68.0
Administrative & Institutional				
Number of constraints (A)	2.7	-	1.1	0.0 - 4.0
Weather/Climate				
Unusual conditions/ calamities (W)		30		
Macro-Economic & Political				
Change in GDP (E_1)	20.2	-	7.2	12.0- 35.0
Occurrence of war/ instability (E_2)		20		

* 35% reduction and 30% expansions, dummy variable.
** 10% reductions and 55% additions.
\+ Mean deviation between estimated and actual economic rate of return.

Table 2: Time Overrun Regression Results

Independent Variables	Regression Coefficients			
	TD(1)	TD(2)	TD(3)	TD(4)
D_2	--	--	17,093 (1.39)	17.404 (1.36)
P_1	0.314* (2.19)	--	0.292* (2.07)	--
P_3	--	(-) 7.611^{+} (-1.820)	--	(-)6.934$^{@}$ (-1.680)
E_2	45.497* (2.17)	45.261* (2.08)	50.180* (2.43)	50.145* (2.33)
Intercept	16.33	57.27	9.43	46.98
R^2	0.39	0.35	0.46	0.41
Adjusted R^2	0.36	0.31	0.40	0.34
F	5.44	4.49	4.46	3.76
PR>F	0.01	0.03	0.02	0.03
N	20	20	20	20

1. t-ratios appear in parentheses
2. * Significant at 0.05 probability level or higher
3. $^{+}$ Significant at 0.10 probability level or higher
4. $^{@}$ Significant at 0.20 probability level or higher

Adjusted $R^2 = 1 - (1-R^2)\ [(N-1)/N-k)]$

where,

N = number of observations
k = number of independent variables

Table 3: Cost Overrrun Regression Results

Independent Variables	Regression Coefficients					
	CD(1)	CD(2)	CD(3)	CD(4)	CD(5)	CD(6)
D_2	--	--	--	--	(-)15.493 (-1.26)	(1)3.991 (-0.29)
I_1	24.100 (1.32)	28.609[@] (1.75)	23.121 (1.14)	--	--	--
I_5	0.892* (2.16)	0.931* (2.33)	--	0.879* (2.08)	--	0.801[@] (1.56)
P_2	0.162 (0.60)	--	0.253 (0.86)	0.308 (1.22)	0.465[@] (1.70)	0.334 (1.21)
E_1	2.274 (1.73)	1.955[+] (1.66)	3.096[@] (2.22)	3.169* (2.75)	4.013* (3.42)	3.255* (2.66)
Intercept	(-)36.532	(-)19.21	(-)51.39	(-)52.64	(-)67.41	(-)54.08
R^2	0.58	0.57	0.45	0.53	0.46	0.53
Adjusted R^2	0.50	0.52	0.39	0.47	0.40	0.44
F	5.16	7.05	4.34	6.03	4.50	4.29
PR>F	0.008	0.003	0.020	0.006	0.018	0.016
N	20	20	20	20	20	20

1. t-ratios appear in parentheses
2. * Significant at 0.05 probability level or higher
3. [+] Significant at 0.10 probability level or higher
4. [@] Significant at 0.20 probability level or higher

Adjusted $R^2 = 1 - (1-R^2)\ [N-1)/(N-k)]$

where,

N = number of observations
k = number of independent variables

Table 4: Rate of Return Regression Results

Independent Variables	Regression Coefficients RD(1)	RD(2)	RD(3)
I_3	(-)2.424+ (-1.95)	--	(-)3.106* (-2.67)
I_4	--	(-)1.752@ (-1.37)	--
E_2	51.130* (2.14)	37.497@ (1.46)	37.498@ (1.68)
CD	(-)0.325@ (-1.37)	(-)0.380@ (-1.53)	--
Intercept	41.45	49.38	38.55
R^2	0.39	0.32	0.31
Adjusted R^2	0.32	0.24	0.27
F value	3.36	2.51	3.90
PR>F	0.045	0.096	0.04
N	20	20	20

1. t-ratios appear in parentheses
2. * Significant at 0.05 probability level or higher
3. + Significant at 0.10 probability level or higher
4. @ Significant at 0.20 probability level or higher

Adjusted $R^2 = 1 - (1-R^2)\ [(N-1)/(N-k)]$

where,

N = number of observations
k = number of independent variables

monetary values might increase the explanatory power of the RD regression equation.

The coefficients of variables in the regression analysis imply that time deviations can be reduced by increasing the appraisal efforts or inputs (appraisal man-days per million dollars of total cost) of the projects. In addition, political instability, and the larger size or magnitude of the project in terms of total cost led to time overruns, and cost deviations can be reduced by improving the predictive efficiency of inflation, F.E. rate and GDP changes. It was also found that projects with longer duration have higher cost deviations, and the rate of return deviation can be improved by increasing the predictive efficiency of inflation in terms of changes in consumer prices and money growth and also by increasing the efficiency of cost estimations. In general, implementation of projects with a long duration or implementation period as well as large amount of investment should be avoided if the political instability and/or higher inflationary situations are observed or anticipated in the host country. Norgaard suggests the sequential investment in smaller projects as the future unfolds.[6]

The use of economic rate of return as a performance indicator in agricultural projects has limitations and may not be the best proxy for performance of projects. A better measure may require more factors concerning project outputs and their prices, and also the project benefits. But in the presence of multiple objectives, which are common with agricultural projects in developing countries, the social outputs of the projects are difficult to measure and value.

One of the statistically insignificant predetermined variables in this study which World Bank audits have deemed important is the administrative and organizational constraints affecting the agricultural projects in many developing countries at every stage of the project cycle. These administrative and organizational constraints are very complex and ideally require primary data on both objective as well as subjective measurements for ex-ante evaluation purposes. This study was only able to count the number of contraints mentioned in the ex post audits and it was not possible to assign weights from the available secondary evidence. The past experience of the World Bank has shown that overestimation of the quality of the local institutions and administrations has led to delays in project implementation and cost overruns of agricultural projects in many developing countries.[7]

Some implications for interpreting the regression results should be noted due to the presence of multicolinearity among the key independent variables. Some key variables may have been excluded from the regressions because of multicolinearity with other variables. For example, political instability is a statistically significant predetermined variable in explaining time overrruns. As it has a high correlation with percent change in F.E. rate variable, the explained variance of the TD regression equation increases if both of these variables are included together in the equation. But if the change in F.E. rate variable is included in the equation without the political instability variable, the former variable becomes statistically insignificant.

Much more ex post research is needed on the factors related to errors in ex ante evaluation of agricultural projects in developing countries. Agriculture is a dominant sector in most of these countries and internal and external attempts to stimulate development of this sector involve a major

allocation of scarce resources. Significant differences in ex ante and ex post evaluation of time required for implementation, project costs and project benefits can and probably has resulted in a significant misallocation of scarce resources. Finally, even if ex post research fails to adequately explain errors in ex ante project evaluation, it may provide more realistic bounds for sensitivity analysis.

Footnotes

[1] Gittinger, J.P. Economic Analysis of Agriculture Projects, The Jonns Hopkins University Press, Baltimore, 1975, p. 3.

[2] Ibid. p. 5.

[3] Carruthers, L.D. "Applied Project Appraisal: The State of the Art," ODI Review; No. 2, 1977, p. 14.

[4] Norgaard, Richard B. "Environmental Evaluation Techniques and Optimization in an Uncertain World," Land Economics, Vol. 62, No. 2, May 1986, p. 210.

[5] Oo, Tin Htut, Factors Related to Errors in Ex Ante Evaluation of Agricultural Projects in Developing Countries, M.S. Thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio, 1986.

[6] Norgaard, Op. Cit. 212.

[7] The World Bank. Seventh Annual Review of Project Performance Audit Results 1981, Washington, D.C., 1981, and The World Bank, Eighth Annual Review of Project Performance Audit Results 1982, Washington, D.C., 1982.